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A NEW METHOD FOR TEACHING PHRASING AND FOR INCREASING THE SIZE OF READING FIXATIONS*

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I

The purpose of this paper is to describe a new method for improving reading by teaching proper phrasing and by increasing the size of reading fixations. A preliminary account of what already has been done in this connection will best introduce our material.

In general, two types of procedure for increasing the span of visual perception have been employed in remedial reading programs. The first of these types uses some form of the tachistoscope. The customary procedure here is to present to the subject for brief periods of time (usually for less than .150 sec.) series of exposure cards containing single words, phrases, or sentences. After each card is exposed, the subject is asked to report either verbally or in writing as much of the stimulus as he was able to apprehend. At the beginning of the training rather simple exposure materials are employed, and the time allowed for perceiving them is relatively generous. Then, as the subject becomes accurate in his reports at this level, the difficulty of the exposure units is gradually increased both as to vocabulary and length, and the exposure time is reduced. End tests usually indicate considerable improvement in the subject's ability to perform in tachistoscopic experiments of this type. Part of this improvement results from the subject's becoming accustomed to the novelty of tachistoscopic methodology, but, in addition, there seems also to be an improvement which represents a real change in his habits of perceiving.

As far as remedial work in reading is concerned, however, the older tachistoscopic procedures (those dealing with isolated word-elements) are limited by the fact that the span of perception scores

* Manuscript recommended for publication by John Gray Peatman, October 28, 1937.

thus obtained bear only a fair relationship to the size of reading fixations, the correlations between the two usually being less than .50. When two functions are shown to be so independently variable, it is not to be expected that training in the one will materially alter the other. This failure of the more usual tachistoscopic techniques to show a significantly high relationship between the tachistoscopic and the reading spans is due probably to the fact that the mere perception of isolated words or of short phrases is not sufficiently comparable to the processes of normal reading. It must not be concluded, however, that all work with the tachistoscope in the reading clinic must inevitably fail, for when,—as in Robinson's[1] method for exposing materials in context,—the tachistoscopic technique is modified to resemble more closely the circumstances of normal reading, correlations as high as .66 may be expected between the tachistoscopic and the reading spans; and when, as in the method shortly to be described, the tachistoscopic principle is incorporated into a procedure which even more closely approximates the processes of normal reading, a still higher relationship between these spans may be assumed to exist.

The second of the older methods for teaching phrasing and for increasing the size of reading fixations is that of indicating, by some means, points of fixation along the lines of ordinary reading material. Various forms of this method have been proposed. Perhaps the simplest of these is Ring and Bentley's[2] technique of drawing vertical lines through the material in such a way as to divide each line into two, three, or more equal portions. With the portions thus indicated, the reader is instructed to apprehend each in a single glance as he reads across the page. A modification of the above is Robinson's[3] method of separating the meaningful phrases within lines by means of additional spacing. Again, the reader is instructed to make only as many fixations as there are phrases along the line. During the initial stages of training with either of the above methods, rather small units are used; and then as the training progresses, the length of these is gradually increased.

1 Robinson, Francis P. The tachistoscope as a measure of reading perception. *Amer. J. Psychol.*, 1934, 46, 132-135.

2 Ring, C. C., and Bentley, Madison. The effect of training upon the rate of adult reading. *Amer. J. Psychol.*, 1930, 42, 429-430.

3 Robinson, Francis P. The role of eye-movements in reading with an evaluation of techniques for their improvement. *Univ. of Iowa: Series on Aims and Progress of Research*, 1933, No. 39.

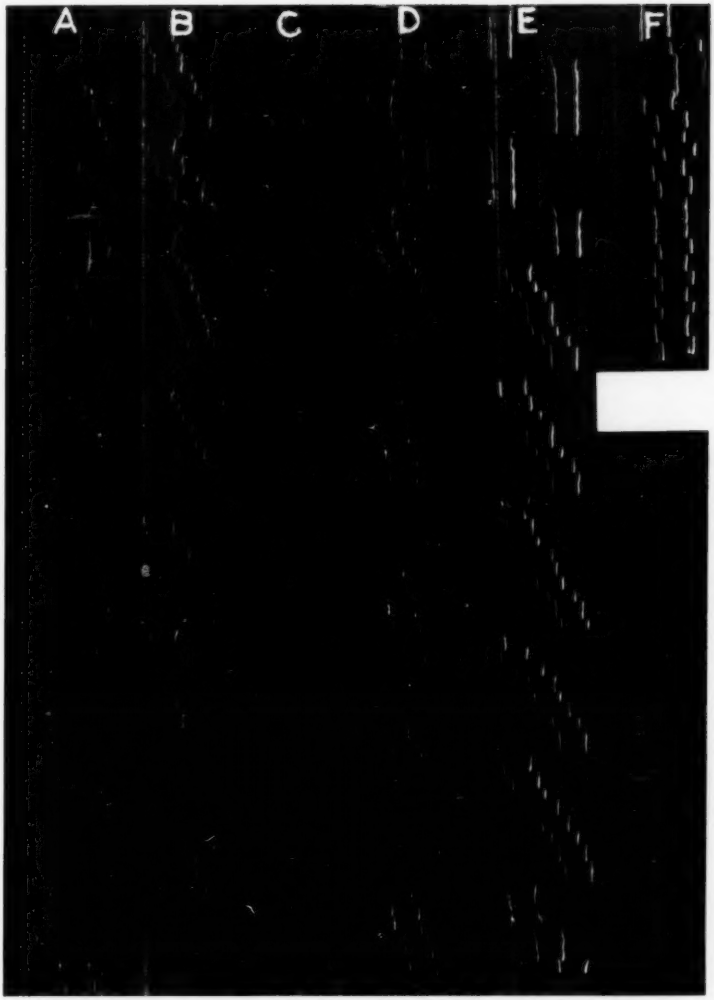


Figure 1. Eye-movement records secured from normal reading (A) and from readings of various forms of pacing exercises (B, C, D, E, F).

In view of the fact that the number of fixations per line varies in normal reading, Robinson's method, in that it permits the number of spaced units per line to vary according to the phrasing which is most logical, is an improvement over Ring and Bentley's rather bizarre arrangement in which the division of lines is identical throughout. A limitation of both methods, however, is that the exercises themselves exert no control over the eye-movements of the reader. Whether or not he makes the number of fixations indicated depends entirely upon his own ability to comply with the instructions. As a consequence, more than one fixation may inadvertently be made in reading the phrases.

II

In an effort to secure an objective check of the efficacy with which such exercises as the above reduce the number of fixations, we have photographed the eye-movements of a group of advanced students of education while they were reading various forms of these exercises. Several records which were accumulated in connection with this research are shown on Fig. 1.[4] These records, selected on the basis of neatness of photography only, show the eye-movements of six different persons, each of whom read a slightly different type of exercise. Record A, introduced for the purpose of comparison, was secured from a person's normal reading of ordinary material. The remaining records were secured from readings of eye-movement pacing exercises taken from the Pressey[5] and the Moore[6] reading manuals.

In her manual, Pressey presents two types of exercises for reducing the number of fixations in reading. The first of these consists of material from which many of the unimportant words have been omitted; and since spaces occur at the points at which words were omitted, the words that remain automatically become arranged in separate groups somewhat after the fashion of Robinson's material. The reader is instructed to skim through the material in such a way as to apprehend each of the separate groups in a single fixation.

[4] A statistical statement of the results of this research is being prepared for publication under the combined authorship of W. F. Dearborn, I. H. Anderson, T. Alper, and A. Reinherz.

[5] Pressey, L. C. A manual of reading exercises for freshmen. Columbus: Ohio State University Press, 1928.

[6] Moore, H. Reading and study aids: a manual for college freshmen and high school seniors. Holyoke: Anker Printing Co., 1935.

If he encounters difficulty in understanding the material on the basis of reading these critical portions alone, he is asked to supply the missing words mentally. Record B shows the eye-movements of a person who attempted to obey these instructions in reading a paragraph of this material. The selection used contained an average of 3.7 phrases per line. Ideally, therefore, this record should show approximately that number of fixations. The record, however, shows an average of almost nine fixations for each line. The failure of this particular person to approximate the number of pauses indicated is by no means atypical, for none of the 25 persons upon whom this experiment was tried succeeded in making an average of 3.7 fixations per line. While some were able to approximate more closely this number, others were even worse offenders in their failure to do so.

In Pressey's second procedure for increasing the size of fixations, the subject is asked to pace his eye-movements according to an arrangement of marks which are placed immediately beneath the important words along the lines of ordinary reading material. Care is taken to instruct the reader to pause only at the marked points. He is expected to perceive the rest of the line in marginal vision or not at all. Records C and D show respectively the eye-movements of two persons,—each of whom read separate paragraphs in which the marked points of fixation were dashes and dots. The number of targets per line averaged slightly less than four in each selection. The average number of pauses per line in Records C and D, however, is 8.4 and 9.6, respectively. Thus, the same failure to approximate the number of pauses indicated is shown here as was also observed above in Record B. And that this failure is not confined to these individual records is suggested by the corresponding group averages, which were 8.1 and 7.8.

The Moore manual provided the exercises for obtaining the two remaining records in Fig. 1. Record E shows the eye-movements of another individual who attempted to pace his fixations according to an arrangement of dots. Instead of being distributed selectively as in Pressey's system, however, the dots were arranged to direct the reader to the same three points in each line of the passage. That this system for controlling eye-movements is no more effective than the foregoing is shown by the excessive number of fixations per line in Record E.

The exercise employed in obtaining Record F differs from each of the preceding. Here, the material was printed in narrow lines,

resembling somewhat the columns of type used in magazines such as the Readers Digest. The subject is instructed to fixate approximately at the center of the top line, and then to read down in a vertical column of eye-movements as he attempts to perceive each succeeding line in a single fixation. If the subject were successful in executing these instructions, a photograph of his eye-movements would show two straight, parallel lines. Record F shows, however, that one of our subjects made fourteen pauses in reading seven lines of this material. At only one place is there any indication that he was able to comply with the requirements of the experiment. This occurs about midway through the record at the point where the lines straighten out for a slightly longer period.

In reading all of the above pacing exercises, the subjects were instructed to sacrifice meaning, if necessary, to the making of correct eye-movements. Thus, the failure of these exercises to provide the type of training intended cannot be explained in terms of the reader's being obliged to satisfy a requirement of comprehension; and that the explanation probably lies elsewhere is implied by the results of other experiments which show that even after the subject has studied the material carefully beforehand, he is only slightly better able to pace his eye-movements in a final reading of it before the camera. Nor can this failure be explained in terms of an unfamiliarity with the procedure, for before any records were taken all subjects were given considerable practice in reading these exercises and ample time in which to become accustomed to the technique of eye-movement photography.

III

The above data were presented to show that for the purpose of eye-movement training it is not sufficient merely to indicate the places along lines at which the eyes should pause. If this is all that is provided, the reader may continue to read as before. A control which will prevent him from making superfluous fixations is therefore needed. In using such a control, however, it is essential that the circumstances of normal reading be preserved as nearly as possible. Otherwise, the method may have only slight value as a means of altering an individual's reading habits. The problem of providing this control of eye-movements without at the same time perverting too seriously the ordinary reading situation is not easy to solve.

As was indicated at the beginning of this paper, the tachistoscope has been variously employed in attempts to widen the perceptual span in reading. It was also noted that the use of these methods was limited by their failure to approximate closely enough the processes of normal reading. Yet, since the time of the exposures can be so manipulated as to permit only a single glance of the materials shown, the tachistoscope does provide a means for controlling eye-movements. And since the measure of the span thus secured shows some correlation with the size of reading fixations, a solution of our problem may still lie in some modified use of the tachistoscope. What needs to be done, of course, is to incorporate the tachistoscopic principle into a procedure which, even more closely than its predecessors, approximates normal reading. This, we have attempted to do in the method described below.

The reading materials used in our method have been prepared for presentation by means of motion picture projection. Two types of exercise are provided by each of a graded series of films. At any one level, the first part of the film shows successive units of the line exposed discretely across the screen. Although each new phrase comes into view almost immediately after the preceding one has disappeared, enough time is allowed to elapse between exposures to cause the new phrase to appear so sharply that the reader's eyes are attracted to it. In the return sweep to the first phrase of succeeding lines, the reader is always directed to a slightly lower level than that at which the phrases of the immediately preceding line were shown. Thus the subject reads both across and down the screen in a manner similar to that which he employs in reading a page in a book. As soon as the reader has reached the lower limit of the exposure field, he is directed back to the top where the first unit of a new section of the material has come into view. The intervals between exposures are so controlled that the reader has ample time in which to make both the return sweeps and the movements from the end of one section of material to the beginning of the next.

Approximately midway through the film the form of the presentation is changed. Successive units of the line are again exposed across the screen. As each unit is shown, however, it is permitted to remain on the screen. Thus instead of being shown in isolation, each unit is added to the material already exposed. Units continue to be added until the screen area is filled with a section of material. This section then disappears, and, after a brief interval during which

the reader redirects his eyes to the top of the screeen, the first phrase of the next section appears.

In reading both of the above types of exercises, the reader attempts to keep pace with the rate at which he is being led through the material. It is particularly important that he not fall behind, especially in reading exercises of the second type. A lag may occur here, because, although a new unit has been added, the reader may still have a tendency to linger on the phrase which he is reading or even to regress to material previously exposed. In order to train the reader to anticipate the appearance of the next unit and to move his eyes to it as soon as it appears, he is first given practice in reading the isolated phrases. In this method of presentation, a lag cannot occur on the above basis, for since each phrase disappears in its turn nothing remains on the screen to inhibit the eye-movement which is stimulated by the sudden appearance of the next unit. When the new phrase appears, the eyes are immediately attracted to it. Once the reader is habituated to following the sequence of exposures in reading materials of the first type, he seems to persevere quite readily in these habits when the method of presentation is changed to the second form.

In summary, then, although the first method does not approximate the circumstances of normal reading as closely as the second, it does more effectively draw the eyes along in time with the periodicity of the exposures. By using the methods as a team, however, one benefits by the advantage of each without being penalized by the limitations of either.

In order to describe the above exercises in more detail, it is necessary first to describe the method of preparing them. The reading materials used in making the films consist of interesting narratives of true adventures, travels, and so forth.[7] Each story is adapted to the recognition of the children of the level for which a film is being prepared. Films are to be provided for students in the grades, the high school, and in college.[8] The average length

[7] Acknowledgments are due to the Charles E. Merrill Company, the Johnson Publishing Company, and the Union Pacific Railroad Company, for permission to use copyrighted materials.

[8] A film for use at the pre-primer level is also to be prepared. This film will show successive blocks of a picture exposed across the screen in such a way that each scene will contribute to the completion of a picture story. Such a film should have value in teaching children at the pre-primer level the conventional left-to-right order of eye-movements required in ordinary reading.

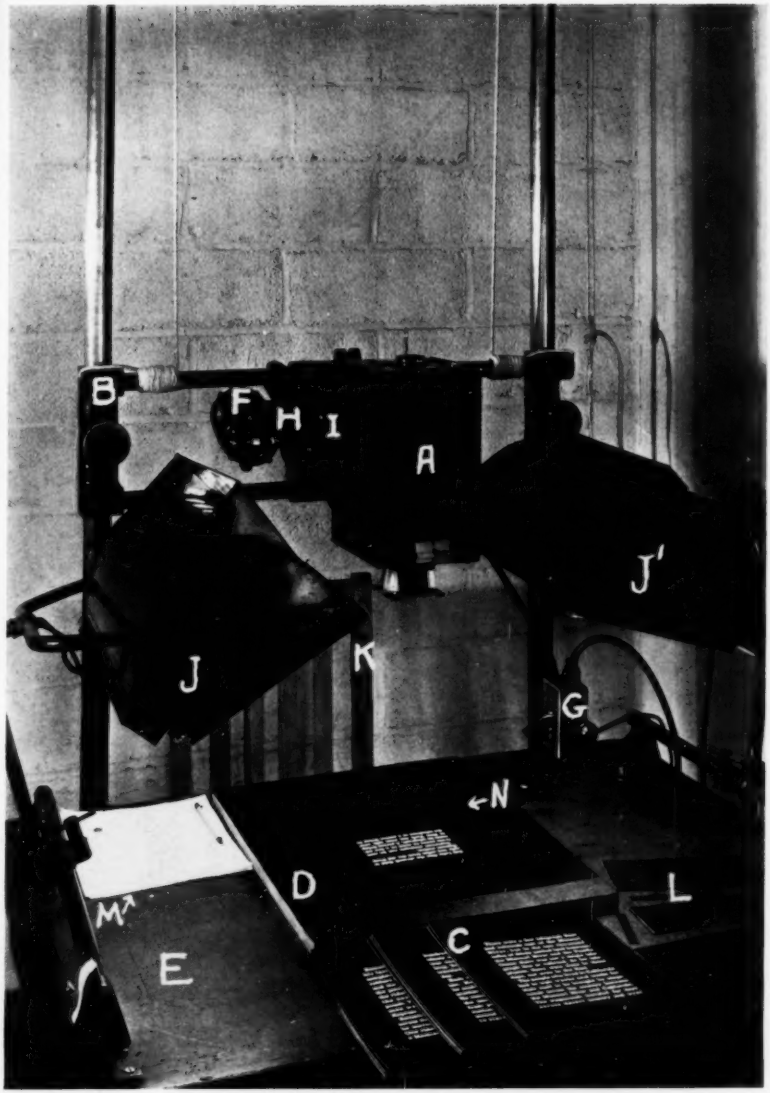


Figure 2. View of camera in position for photographing the reading material. (A) Motion picture camera, (B) animation stand, (C) negative title cards, (D) card holder, (E) working table, (F) synchronous motor, (G) hand operated switch, (H) split segment cam, (I) shaft, (J. J') light reflectors, (K) operator's chair, (L) masks, (M) copy indicating phrasing, (N) card position marker.

of selections is approximately 2000 words. The stories used in the preparation of films for younger children are somewhat shorter than this; those employed in making films for older children and adults are somewhat longer.

For the purpose of photography, all selections are printed on negative title cards (white print on black background), 11 by 8½ inches in size. Each card contains a maximum of 16 lines. Although all stories are printed in the same length of line (128 mm.), smaller type sizes are used in setting up the selections as the levels for which they are adapted become more advanced. It necessarily follows that the passages for younger children average fewer words per line than the passages for older children and adults.[9] In spite of the is presented with nearly the same average number of exposures per line at all levels. The films thus become arranged in an ascending order of difficulty not by reducing the average number of exposures per line at the higher levels, but by including a larger average amount of material in each exposure, and by reducing the exposure time. Not only is the average number of exposures per line nearly the same at all levels, but the average extent of the return sweeps and of the forward shifts within lines is also held constant by photographing all selections over the same width of frame. The advantage of this method of presentation is that the reader is encouraged to adopt the same attitude as far as eye-movements are concerned regardless of the level at which he is reading.

In order to photograph the materials the stage is set as shown on Fig. 2. The camera (A) is mounted vertically to an animation stand (B), the cards (C) being placed beneath the camera lens in a holder (D) fastened securely to the working table (E).[10] A synchronous motor (F) drives the camera through a 150 to 1 reduction gear. The electrical circuit is controlled by a hand operated switch (G) which is in parallel with a split segment cam

[9] The same effect could be obtained, of course, by printing the various selections in different line lengths. This method is not so desirable, however, since the position of the camera would have to be changed each time a change occurred in the length of line which was being photographed. The present method permits the position of the camera to remain fixed.
fact, however, that the words per line vary in this way, the material

[10] Although a camera which records on 16 mm. film can be used in this work, it is more satisfactory to use a camera which records on 35 mm. film. The larger camera not only holds more film, but 35 mm. negatives are easier to handle and to edit than the 16 mm. size. It is a small matter to make 16 mm. reduction prints from the 35 mm. negatives.

(H) on the slow moving shaft (I).[11] The lighting is controlled by a pair of obliquely placed reflectors (J,J'), each of which carries two 100 watt bulbs. The operator sits on the chair (K).

With the stage thus set, the first card of a selection is placed into the holder. Since the area occupied by the print on each card is such that one-half of the lines when centered in the film aperture just fill a frame, only the first half of the material is centered directly beneath the camera lens (Fig. 2).

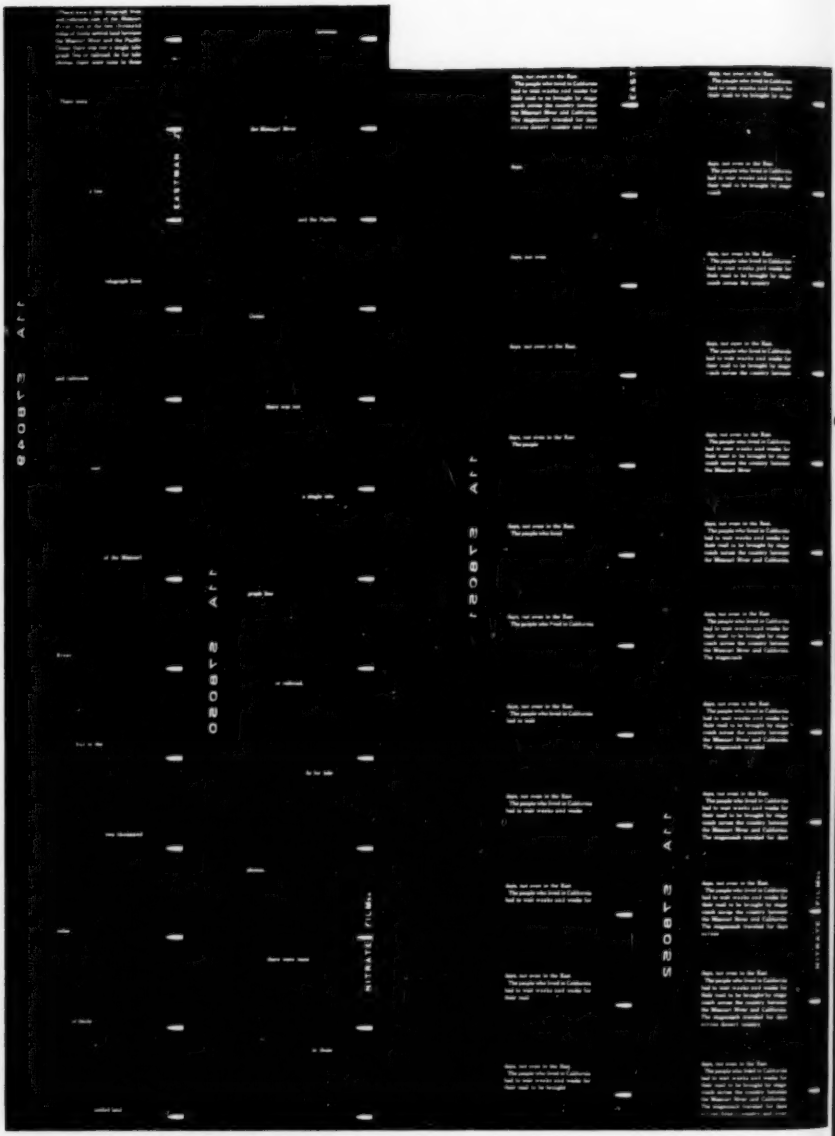
The technique of preparing the first type of exercise contained on each film is as follows: The operator, having indicated the phrasing on copy beforehand (M, Fig. 2), takes note of the first phrase to be exposed in the first line.[12] He then masks all of the material except this phrase.[13] With only this phrase showing, the operator exposes the number of frames of film which, when projected at the proper rate, will show the phrase on the screen for the time desired.[14] Then, after having exposed a single frame with all of the material covered, he changes the placement of the masks so that only the second phrase to be photographed in the first line is showing. After this phrase has been photographed another blank

[11] The switch is used merely to start the motor. Once the cam is in motion, it keeps the circuit closed for the period necessary to expose one frame. When it is necessary to expose more than one frame, the switch is held closed. A count of the exposures is made, of course, by noting the number of revolutions of the cam. The slow rate of exposure (12 frames per min.) enables the operator to make an accurate count.

[12] Insofar as possible an attempt is made to divide the material into meaningful units.

[13] The masks consist of black cardboard strips cut from plain negative title cards (L, Fig. 2). Since the edges of these masks have also been blackened, nothing is recorded on the film except the uncovered print. The shadows cast by the edges of the masks are absorbed by the black background. If the material were printed black on white, however, these shadows would show.

[14] The number of frames exposed per phrase will vary according to the level to which the passage is assigned. At the lower levels a slightly larger number of frames is exposed per phrase than at the higher levels. Another way in which the time of exposure on the screen is varied is by varying the projection rate. Using a standard model of 16 mm. projector, we have found that these films may be safely shown at rates ranging from 14 to 28 frames per second. Thus, if an average of seven frames of film were exposed per phrase, at a projection rate of 14 frames per second the average time of exposure per phrase on the screen would be ½ second. If the projection rate were increased to 28 frames per second, the average exposure time per phrase on the screen would be ¼ second. The latter figure quite closely approximates the average duration of the pauses in adult reading. The important thing to remember in this connection, however, is to control the exposure time so that the reader will be limited to one fixation per phrase.



A B

Figure 3. Sample films showing two types of exercises: (A) phrases prepared for presentation in discrete form; (B) phrases added to the material already exposed.

frame is introduced, and the placement of the masks is again so changed that now only the third, and say the last, phrase in the line is showing. This phrase is photographed, three frames with all of the material covered are exposed, and the masks are so placed that only the first phrase to be photographed in the next line is uncovered. The above routine is repeated until the end of the section of material is reached. At this point 15 frames of film are exposed with all of the material masked.[15] With one-half of the material on the card thus photographed, the card is moved forward in the slot of the holder so as to center the other half on the film.[16] This section is then photographed in the same way as the first. The above routine is repeated with the next card in the selection and with as many more as are to be prepared in the form of the first type of exercise. Fig. 3A shows how the exercises photographed by means of this technique appear on the films. In order to conserve space, all blank frames have been omitted, and only one frame per phrase is shown. The section of material used in the photography is presented on the first frame.

In preparing exercises of the second type, the operator modifies the above technique as follows: Instead of masking all of the material except the phrase being photographed, he so manipulates the masks as to show not only this phrase but also all of the others previously photographed. Thus, only the first phrase in any one section of material is photographed alone. The second phrase is photographed together with the first; the third, with the first two; and any following one, with as many as have preceded it. The blank frames between phrases within lines and at the ends of lines are omitted. At the end of each section, however, the usual 15 frames are exposed with all of the material masked. A sample film on which, again, only one frame per phrase has been photographed is presented on Fig. 3B.

[15] The reasons for inserting the blank frames at the places indicated has been noted above. The single frames between phrases within lines allow enough time to elapse between successive exposures to cause the new phrase to appear on the screen so sharply that the reader's eyes are immediately attracted to it. The larger number of blank frames at the end of each line and section are inserted in order to allow the reader ample time in which to make his return sweeps and the eye-movements from the end of one section of material to the beginning of the next.

[16] The position to which the card must be moved in order to center the second half of the material in the film aperture has been determined in advance and indicated by markers on the holder (N, Fig. 2). The operator simply aligns the bottom edge of the card with these markers. No readjustments of the camera or of the card holder are necessary.

IV

It has already been emphasized that any method for increasing the size of fixations, to be effective, must both exert a control on the reader's eye-movements and reproduce the processes of normal reading as nearly as possible. As we see it, the principal advantage of a photographic technique is not so much that it enables one to control eye-movements—any tachistoscopic method may do this—but that, as a consequence of its flexibility, the exercises produced may be made to approximate the context of normal reading to an extent not easily accomplished by mechanical means. Multiple-shutter tachistoscopes, for example, although they may be so constructed as to present successive phrases in a left-to-right direction, permit only a fixed number of exposures per line, whereas in normal reading, of course, the number of pauses per line varies.[17] Furthermore, all lines are presented at the same level and the successive units of each are always shown at the same places. In normal reading the subject reads both across and down the page, and the location of his pauses varies from line to line even when the number per line is the same or nearly the same. Finally, since the exposure time, too, is fixed by setting the speed control, during any one showing all phrases are exposed for the same period. The duration of reading pauses does not show this constancy.

A photographic technique is not subject to the above restrictions. The number of units exposed per line may vary, depending upon the phrasing which is most meaningful. In our films, for example, although the usual number of exposures per line is either three or four, some lines are presented in as many as five or six, others are shown in only two. And as has already been indicated, the effect of reading intact material is created by directing the reader both across and down the screen.

By the simple expedient of varying the number of frames exposed in photographing them, individual units may be presented for different periods of time. In our films again, for example, unusual expressions, unfamiliar names and places, difficult words, and unusually long phrases are exposed for slightly longer periods than the average on their first occurrence in the text. Short phrases, common words, and familiar expressions, on the other hand, are shown for a somewhat briefer time than the average, and only a very elusive

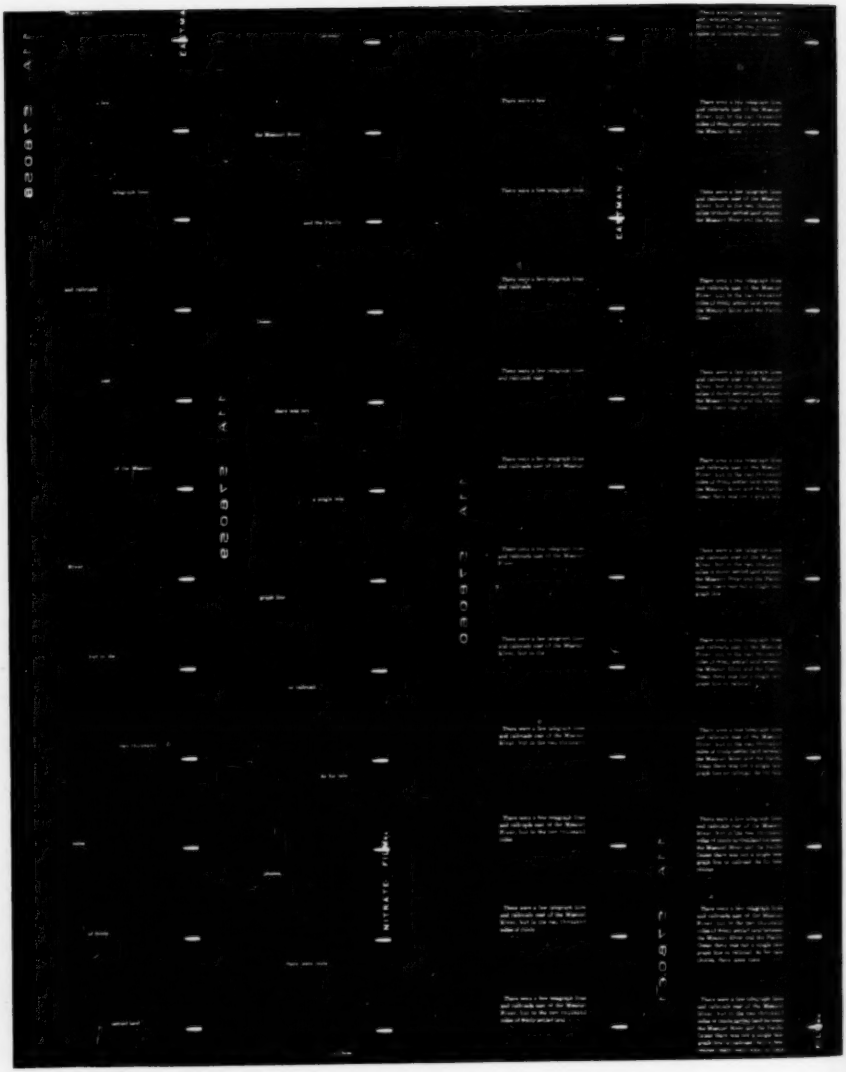
[17] Perhaps the most elaborate of such instruments is the Metron-O-Scope distributed by the American Optical Company, Southbridge, Massachusetts.

glimpse is given of non-essential words and of elements that can readily be supplied from context.

The technique may be variously modified as other needs arise. Pauses may be introduced at the ends of sentences to indicate breaks in thought. The first unit in each new line and section may be shown for a slightly longer period in order to permit the reader to get adjusted for the next succession of phrases. When units recur in the text, after their first few appearances the time allowed for reading them may be reduced, or they may be combined with other words to form larger units. The extent to which still other variations may be introduced is contingent upon the available information regarding the specific effect that such factors as sentence structure, punctuation marks, the part of the line or of the sentence being read, and so forth have on the number and duration of reading fixations. Several investigators, notably Fairbanks,[18] have reported data which are pertinent in this connection.

A photographic technique permits a further refinement. As thus far described, the above films either present the successive units discretely or they are added to the material already exposed. In ordinary reading, however, the successive units fixated do not emerge unexpectedly in this way. During the period of the reading pause, the reader perceives not only the words which fall in direct vision, but he sees also the vague outlines of words rightward along the line. Although these peripherally seen words are not fully cognized, it would seem that they do produce an awareness sufficient to determine the word or phrase on which the eyes next shall pause; for unless there were such awareness, it would be exceedingly difficult to explain the accuracy and the selectivity with which the subsequent fixation is made, especially in superior reading. It should also be noted in this connection, of course, that marginal impressions of material already read contribute to the context. At any rate, a method which fails to permit the reader to benefit by these marginal impressions is limited, insofar as reproducing the processes of normal reading is concerned. Even in the second form of presentation described above, this limitation is only partially overcome, for although the reader is able to benefit by a marginal view of material already exposed, he is denied the rather more important benefits which accrue from a pre-fixational view of material yet to be read.

18 Fairbanks, G. The relation between eye-movements and voice in the oral reading of good and poor silent readers. *Psychol. Monog.*, 1937, 48, No. 3, 78-107.



A B

Figure 4. Sample films showing exposure of phrases in context.

By means of either a multiple-exposure or a multiple-printing technique, it is possible to remedy this fault as shown on the sample films of Fig. 4. The refinement introduced here is obvious from examination. In the first pair of films (A), although the method of exposure is the same as that employed in the first type of exercise described above, the successive units appear in context rather than in isolation. The difference in luminosity between the phrases exposed and the background of text provides the contrast necessary to attract the eyes to each phrase in turn. Yet during the period of any direct fixation, the reader may profit by the contributions of marginal vision as he does in normal reading. The other pair of films (B) shows how our second method of presentation appears when it is combined with an obscure image of the text to be exposed. In the present circumstances, however, this method does not contribute anything not accomplished by the first, since the phrases are now exposed in context in both methods. In fact, the first method is rather to be preferred, inasmuch as the greater force with which this method draws the eyes along is the feature to be capitalized.